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Cooper, William

MR. COOPER'S PAPER

ON

BIG-BONE LICK, KENTUCKY.

(*From the Monthly American Journal of Geology*, &c.)

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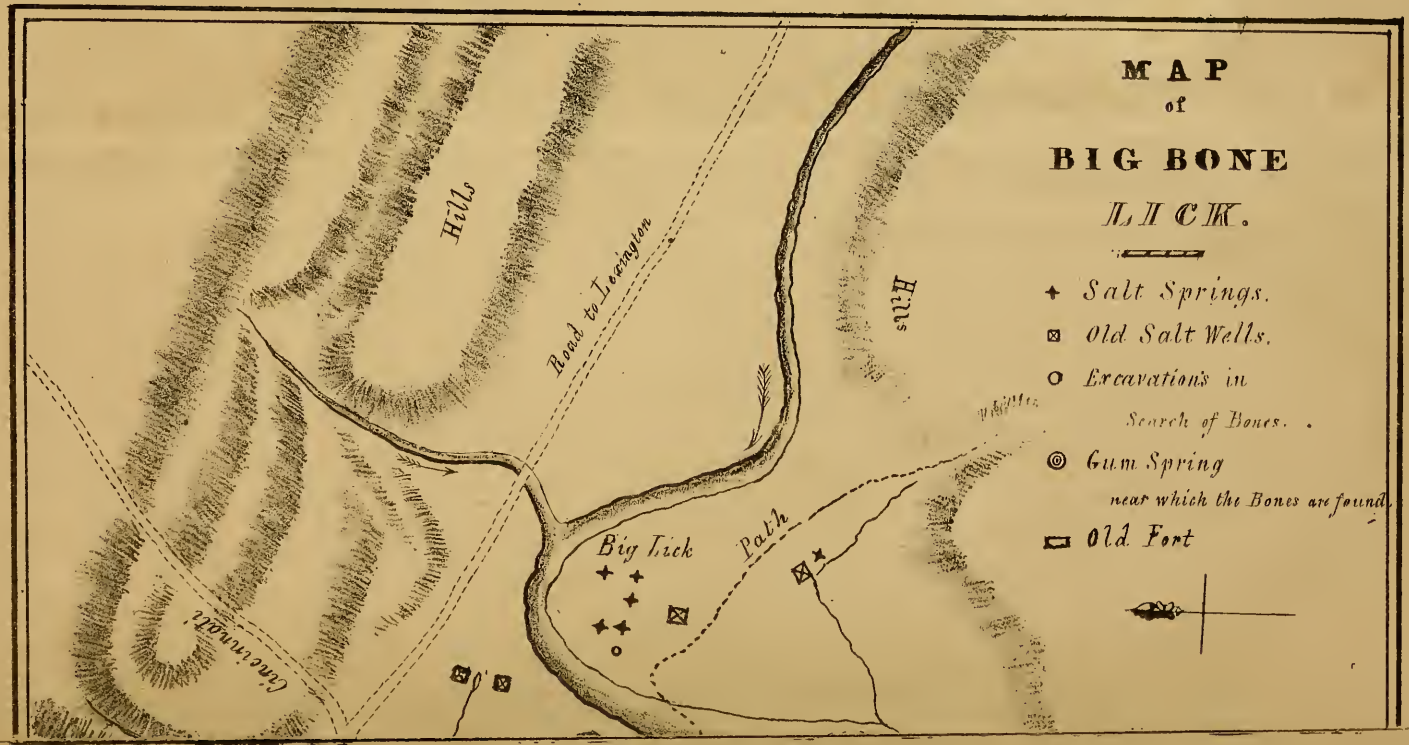
MAP
of
BIG BONE
LICK.
Salt Springs.
Old Salt Wells.
Excavations in
Search of Bones.
Gum Spring
near which the Bones are found.
Old Fort
Hills
Road to Lexington
Hills
Big Lick
Path
Limestone
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Old Channel
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New Cut
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River Creek
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NOTICES OF BIG-BONE LICK,

Including the various explorations that have been made there, the animals to which the remains belong, and the quantity that has been found of each; with a particular account of the great collection of bones discovered in September, 1830. By WILLIAM COOPER, member of the Lyceum of Natural History of New York, of the Academy of Natural Sciences of Philadelphia, the Zoological Society of London, &c.

BIG-BONE LICK, so celebrated for the remains of unknown animals that have been found buried there, is situated in a small valley in Boone county, in the northern part of Kentucky, within two miles of the left bank of the Ohio, about half way down; eighty miles distant, northerly, from Lexington, and twenty south-westerly from Cincinnatti, in Ohio.

By licks are meant, in the western country, springy places, naturally affording salt, in search of which, the various species of herbivorous animals, both wild and domestic, resort to them in great numbers. At Big-bone Lick, the salt is deposited from numerous springs, rising through the soil over a surface of several acres. There are likewise several streams of fresh water, that enter the valley from different sides; and these uniting, form a small river, which, taking a southerly course, discharges itself at the distance of twelve miles, into the Ohio.

The quantity of fossil bones which appear to have been brought together at this place, and deposited within a very small area, is truly wonderful. An authentic account of all that have been found during the last ninety years, such as might enable us to make some estimate of the number of individuals, at least of the larger animals, whose remains were here intermingled, as well as to form some probable conjecture respecting the circumstances under which they perished, and to which they owe their assemblage in this spot, would be at this day most desirable to possess. But it is too late to hope for this. Quantities almost exceeding belief, and of which no record has been kept, have within that period been carried off, and dispersed, no one can now tell whither.

The present communication comprises such information as the writer has been able to glean, of the various explorers of this celebrated place; a notice of the animals which have been found here, and the quantity of remains of each; with a description of the ground and other attendant circumstances that can throw any light upon its theory. This must be, in several particulars, imperfect: and any person who may be in possession of authentic materials relative to this subject, is hereby invited to make them known, or to communicate them to some competent person for that purpose. It is only in this manner that we can expect to supply any of the numerous desiderata in the history of Big-bone Lick.

Chronological Notice of the Explorers of Big-bone Lick.

Longueil, a French officer, seems to have been the first who procured fossil bones at this place. They were brought to him from a morass near the Ohio, by some Indians who belonged to his party. This was in 1739.

Colonel George Croghan, on his passage down the Ohio, in 1765, stopped at Big-bone Lick, and is the first white man who is known to have visited it. His description of the place as it appeared at that time, will be found in another part of this memoir.

General William H. Harrison of Ohio, was there, and obtained many bones in 1795; and the French general Collaud, as nearly as I can ascertain, about the same period.

Dr. Goforth of Cincinnati, was the next. He made large excavations, and found a great quantity of bones, which was about the year 1804; the precise date I have not been able to learn.

He was succeeded by General Clark, the distinguished traveller, who was there in 1806.

The Western Museum Society of Cincinnati, have caused various examinations to be made for bones, and many more have been carried away by travellers and others, within the last twenty-five years.

The author, in company with Mr. I. Cozzens, made a journey to Big-bone Lick in the summer of 1828. We caused several excavations to be made, and collected every thing that seemed likely to add to our stock of information concerning the place.

After all these various explorations, Mr. Benjamin Finnell, who resides here, and had previously made considerable discove-

ries of bones, undertook another, so recently as the month of September, 1830. It proved one of the most successful that has ever been made.

His example encouraged Mr. William Bullock, now also of Kentucky, to undertake another search immediately after. Mr. Bullock likewise obtained a rich and valuable collection; since which all further operations have been forbidden by the present proprietors of the land.

These various collections will be more particularly noticed, as well as the materials now existing will enable me, when treating of the animals to which the bones respectively belong. But it is much to be regretted, that the intelligent men who have enjoyed the opportunities, have generally omitted to furnish such descriptions as would now be useful for our purpose. We possess no satisfactory account of what was discovered previous to the visit of General Clark; and of those, even, which he obtained, no sufficient description has yet been published. A small part is described by Cuvier in his great work; and a few have also been made known by Dr. Wistar. The remainder is still preserved in this country, and it is to be hoped we shall not be allowed to remain long ignorant of what it consists.

Extinct animals found here, and quantity of remains of each species.

The remains found at Big-bone Lick, belong partly to animals whose species is now extinct, and partly to others, still numerous within the United States territory. Our present inquiries relating principally to the former, the other will not be especially mentioned, except in the case of some which have been included among the cotemporaries of those more ancient quadrupeds. Of these the mastodon being the most extraordinary, and that which furnishes the greater portion, by far, of these remains, first deserves our attention.

1. Great Mastodon. (*Mastodon maximus*,* Cuvier.)

Such is the quantity of bones and teeth of this species of mastodon, that has been disinterred at Big-bone Lick, that although it is the most common of American fossil quadrupeds, and has been found in almost every part of the United States, yet all

* M. Cuvier having finally adopted this name, we shall make use of it, instead of that formerly given, M. giganteum. Vide Oss. Foss. ed. 3. ch. v. p. 527.

that have been discovered elsewhere, would not, united, equal the number obtained at this single locality.

Longueil and Croghan each took but five or six teeth and bones, being as much as their means of transportation at that time permitted.

General Harrison, as he informed several members of the Lyceum of Natural History, when in New York, about three years ago, procured as many as filled thirteen hogsheads, which were sent up the Ohio to Pittsburg; after which he never heard what became of them. General Collard, about the same time, obtained twenty-four pieces.

It is not to be presumed that these bones all belonged to the great mastodon; but I am induced to mention them here, on account of the probability that a majority of them did. In all the collections of bones made here, of which any precise account has been given, these always constitute the great mass. And this, unfortunately, is as much as is now known of all that was removed previous to the exploration made by Dr. Goforth.

Concerning this, our information is likewise very scanty. He states that he got of mastodons' teeth alone,* weighing from twelve to twenty pounds, "as many as a wagon and four horses could draw," besides which were many large tusks and bones, no doubt principally belonging to the same animal. A large part of this collection passed into the hands of Mr. William Bullock, so well known for the services he has rendered to natural history. Mr. Bullock, now residing in this country, I applied to him for information concerning them, when he favoured me with the following reply, dated Nov. 24, 1828.

"In regard to the fossil bones of which you request information, it is about twenty years since I purchased of Thomas Ashe, twelve cases of bones, which I afterwards discovered were collected by Dr. Goforth, a few years previous to the time I bought them. According to Ashe's account, who was present when many of them were collected, they were found several feet below the surface, and under the stratum of graminivorous bones, which you must have observed on the bank of the small river that passes near the spring.

"I had about twenty back teeth, exclusive of perhaps eight

* See his letter to Mr. Jefferson, published in Cramer's Ohio Navigator, 8th ed. pp. 260, 262.

or ten in different jaws, and about ten tusks, among which were those of three different animals. The greatest part of these bones is now in the museum of the college of surgeons in London. A beautiful specimen of the fore part of the head, with all the delicate nasal bones entire, is in the possession of professor Monroe, of Edinburgh; and the late Dr. Blake, an eminent dentist of Dublin, had from me a very interesting collection of teeth in various stages of growth and decomposition."

It will be perceived that the quantity here mentioned by Mr. Bullock is small, in comparison with that which Goforth,—of whose correctness there is no reason to doubt,—states to have been obtained by him. A great part of his collection, therefore, still remains to be accounted for.

The next considerable collection known to have been made here, was by General Clarke, at the instance of Mr. Jefferson. The bones were brought to Washington in 1807, where they were seen by Dr. S. L. Mitchill,* who published a brief notice of them in the eleventh volume of the Medical Repository. They were divided by Mr. Jefferson, according to Dr. Wistar, who selected them, between the American Philosophical Society, and the French Institute. Dr. Mitchill says, there were three parcels made, of which Mr. Jefferson reserved one for himself. However this may be, there are now very few fossil bones preserved at Charlottesville, and it is doubtful whether these are from Big-bone Lick.

Those sent to France are described by Cuvier. They consist of an upper and two under jaws with teeth, five detached teeth, a radius, tibia, and several bones of the feet.

The cabinet of the American Philosophical Society, contains of the mastodon, two or three portions of the cranium, one of them comprising a large part of the alveolar process of a tusk, fourteen or fifteen mutilated jaw bones, upper and under, containing teeth, and from animals of various ages, besides large tusks, and pieces of fossil ivory, in considerable quantity, several vertebræ, and a few bones of the feet. The origin of all these is not certainly known at present; but, though some may have been derived from other localities, it is most probable that the

* Whilst sending this sheet to the press, the Editor has received information of the death of this amiable and most eccentric individual. For forty years he has been a conspicuous friend to natural science, and for a great portion of that time he kept the flag of science waving in this country, when he almost stood alone.

majority consist of those discovered at Big-bone Lick, by General Clarke.

The western museum of Cincinnati, and Letton's museum in the same city, contain many relics of the mastodon, nearly all from Big-bone lick. Together there are not less than one hundred pieces, more than half being grinders, of three and more pairs of points. There is, however, in the latter museum, a lower jaw, which is remarkable for having both branches tolerably complete, though the teeth are wanting.

My researches at Big-bone Lick, procured me about seventy pieces, of which the most considerable were as follows:

Two large, and numerous small fragments of tusks, presumed of mastodon.

A small left lower jaw, with one molar tooth, of four points; being the anterior milk molar. This is from a very young individual, probably the youngest yet discovered, the first milk molar being scarcely at all worn.* I obtained likewise several other interesting portions, including teeth and bones, apparently all belonging to this small head.

Four other large portions of lower jaws, all different, but without teeth.

Thirty tolerably perfect separate molar teeth, besides large fragments of others.†

Seven vertebræ, mutilated, and several portions of ribs.

Two portions of scapulæ.

* The *Tetracaulodon* of the late justly lamented Dr. Godman, appears to me, after a careful examination of his specimen, to be another young individual, also of the common mastodon, but older than mine, the anterior milk molars having begun to fall, after having been used until they were worn down. I have stated my reasons for this opinion, in a paper on the dentary system of the mastodon, which I read to the Lyceum of Natural History, in April, 1830. It appears, however, from recent observations, that the lower tusks, which I suppose all of the species to have possessed in their youth, were in some instances permanent during the advanced age of the animal. But whether this was a sexual characteristic, or merely an individual case of anomaly, of which I have seen other curious examples, *I cannot recognize more than one species of mastodon, among the great quantity of their remains found in the United States, which have come under my observation, those just alluded to, included.*

We are happy to find that Mr. Cooper, who has given this subject so careful an examination, and who has had such rare opportunities of studying the dentition of these animals, agrees with us so thoroughly in the opinion we have always expressed on this subject. Vide Monthly American Journal of Geology, &c. Vol. I. No. 3, p. 141.
EDITOR.

† Among these I include one similar to the tooth, also from Big-bone Lick, described by Dr. Harlan, as having belonged to an extinct species of tapir. That it is a young mastodon's tooth, is evident, I think, from the milk teeth still remaining in the head on which the supposed genus tetracaulodon is founded, as well as from the small jaw above described.

Four humeri, much mutilated, three of them from the left side.

Upper extremity of ulna.

Five carpal, two metacarpal, and one phalangial bone of fore foot.

Large fragment of os innominatum.

Another, comprising the acetabulum.

Lower extremity of left femur.

Patella, tibia, epiphyses, gone.

Calcaneum.

Besides numerous fragments, not requiring especial notice, but like the rest, indicating, by their shattered condition, the violence they were exposed to, before their final deposition at this spot. Some appear to have been a little rubbed, but the broken edges are generally sharp, and the surfaces unscratched.

The bones discovered by Mr. Finnell, in September, 1830, form one of the most interesting series belonging to the mastodon, that has probably ever been assembled. Having taken notes of these, while exhibited in New York this summer, I am enabled to give the following descriptive catalogue, in which I have included such anatomical, and other observations, as appeared to be new or interesting. The first will naturally be

A head, more entire than any previously discovered here or elsewhere. It is still, however, too imperfect to enable me to complete the description of this important part, and it is especially to be regretted, that so much is wanting around the exterior opening of the nostrils, that we can derive no aid from it, in endeavouring to determine with certainty, from the structure of this part, whether or not the mastodon was furnished with a trunk. But enough remains to show, that it differed materially from the elephant's in form. It in fact bears more resemblance, in some respects, though totally different in others, to that of the rhinoceros, particularly in the nearly vertical elevation of the occiput, giving the skull the general form of a pyramid, of which the occiput is the base, and the alveolar processes the summit, there being a gradual and pretty regular slope from between these, nearly to the edge of the occiput. It is, however, much broader and flatter on the top, than in

either of these animals.* The following are the principal dimensions.†

	Feet.	In.
From the occiput to the end of the alveolar, from which a part is broken off, . . .	3.	
Breadth over the orbits, ...	1,	$7\frac{1}{2}$
Girth lengthwise, ...	6,	2.
Girth at the occiput, ...	5,	$7\frac{3}{4}$.
Girth of the two alveoles of tusks at their origin,	3,	$8\frac{1}{2}$.
From the outside of the right anterior molar, to the outside of the left, ...	1,	$2\frac{1}{2}$.
From the outside of the right posterior, to the left,		$9\frac{1}{2}$.

One tusk was found fixed in the socket, and the fellow lying near it. They are quite round, slender, and very uniform in diameter throughout, as far as they remain, the ends of both being broken off. The anterior molars being gone, and the posterior, which have four pairs of points, being worn by use, show that the animal was quite adult; though from its small size, and the slenderness of the tusks, it was probably a female. The curve of the tusks forms nearly a semicircle. The longer one measures six feet six inches, with a diameter of five inches.

A large single tusk, which, when first found, was quite entire, though brittle from decay. It is very round, tapers gradually to the point, measures in length nine feet two inches, and in circumference at the root, twenty-three and a half inches. It is remarkable for its slightly sigmoid curve.

Eighteen pieces of tusks, from one and a half, to five feet long. These furnish some curious examples of dentition, from various causes. Some appear to have been worn at the point by use, during the life time of the animal, and still retain a high polish. One or two are laterally abraded, in such a manner as to present a perfect section.

A left upper jaw, with part of the socket of a tusk and one grinder.

* This "flatness of the cranium" was first observed by Messrs. Mitchill and Townsend. See their account of the mastodon found at Chester, May 1817, in Mitchill's Cuvier, App. p. 379.

† Owing to the artificial state in which this head is at present exhibited, it is no longer possible to trace the sutures, or describe the separate bones. The general form is nearly all that can be safely described. For the same reason, no figure is now given.

Left upper jaw, with part of socket of tusk, and two molars.

Right upper jaw, with one molar, and an empty socket.

Right upper jaw, with one molar, from a young individual.

Left upper jaw, with one molar, still younger.

Right upper jaw, with one molar, no empty socket, the enamel whitish.

Right and left lower maxillary bones, each with the posterior molar, which is a little worn, perhaps belonging to one jaw.

Chin of a young individual, with a short truncated beak, in which are the vestiges of sockets of caducous incisors, (similar to the tetracaulodon of Godman.) Part of the right branch remains, with a portion of the root of the anterior right molar.

Two other chins with remains of sockets of anterior molars.

Left lower maxillary, with the posterior molar, and an empty socket, and part of the chin.

Right and left lower maxillary bones, forming part of the same jaw. The right is tolerably perfect, and contains the penultimate and posterior molars, with the sockets of one or two others. The left consists only of the posterior half of the jaw, with the posterior molar, which in both is still partly buried in the ascending branch, showing that the individual was not perfectly adult.

Left lower maxillary bone of large size, with one molar, and an empty socket.

Left lower maxillary of a young individual, with two molars of six points, and a germ, also of six points, but entirely buried in the bone, which is fractured in such a manner, as to expose the germ. From this piece we learn how many molars with six points, the mastodon possessed. From young jaws formerly discovered, it was already known that there were two of four points; and the adult and aged specimens make it evident that there was but one of eight or ten points, on each side, above and below. This gives six on each side, or twenty-four in all, as the total number of molars. They were not, however, all in action at the same time. Probably not more than two at once, were in use at any one period of the animal's life, and finally, none but the posterior molar, with four or five pairs of points, and an irregular heel remained in the jaw.

Left lower maxillary, with one molar of six points, and an empty socket before and behind it.

Right lower maxillary, also with one molar, and two empty sockets.

Right lower maxillary, with only the large posterior molar remaining, and much worn, the sockets of the others obliterated: evidently an aged individual.

Right lower maxillary, with the posterior molar, enamel whitish. The enamel is generally, it must be observed, very dark coloured, and sometimes black.

Left lower maxillary, with two molars of six points, posterior half of the jaw wanting. A young individual.*

Seventy-two molar teeth, presenting examples of nearly all the changes they undergo, from the state of a mere germ, of which the mastoid points alone remain, to that of an old and worn out tooth, in which the roots are completely ossified, and remain uninjured; while the crowns are worn down in such a manner, as to leave the bony substance of the tooth bare of enamel, which merely forms a border round the crown.

Of these molar teeth there are of the various kinds,

One with two pairs of points, and an odd shoulder, representing a fifth point, or possibly an indistinct pair.

Thirty-nine, with three pairs of points.

Fourteen, with four pairs of points, and an odd one. Of these ten belong to the upper jaw, and four, I think, to the lower.

Fifteen with five pairs of points, and an odd one, or heel.—These are all lower jaw teeth, the posterior molar.

Two with four pairs, and three small knobs in a row, besides a heel, and lateral tubercular knobs, and

One with five pairs of points, and two knobs, too irregularly placed to form a pair. These three last are also lower posterior molars.

Five atlas bones, with thirty-one other vertebræ, cervical, dorsal and lumbar. A separate spinal process, though incomplete, is twenty inches long; most of them are very much

* Of the fifteen portions of lower jaws here enumerated, the posterior molar remained in eight. In two of these this tooth had four pairs of points, and an odd point or heel, besides; in the six others, there were five pairs of points, with from one to three irregular knobs.

mutilated, and a part may not improbably belong to the elephant.

Fifteen ribs, more or less broken.

Large sacrum, with portions of ossa innominata attached.

Two portions of other sacra.

Five scapulæ, mutilated. Four retain the condyle.

Seven humeri, all mutilated, and very imperfect. One wants the epiphyses, being from a young and small animal. Another consists merely of the condyles, others are no more than the shaft of the bone, with both ends broken off.

Three ulnæ, of various sizes.

A radius, lower end broken off.

Fourteen or fifteen small bones of the fore feet, among which two cuneiform, and other carpal, and several metacarpal.

A very large and nearly entire os innominatum.

Two others, less entire, and appearing to belong together.

Three others, consisting of little more than the acetabulum, with the thyroid foramen.

A femur, nearly entire, thirty-eight inches long.

Four others, more mutilated, some of larger size than the preceding.

Five other considerable portions of the same bone.

A patella.

Very large tibia, twenty-nine inches long.

Three others, smaller.

Another, of a young individual, the epiphyses wanting.

Two astragali.

Four calcanea.

Immediately after Mr. Finnell discontinued, on procuring the bones just described, Mr. Bullock commenced digging near the same spot. He obtained many mastodon bones, as well as others; but as his collection has never been examined by any anatomist, I have not the means of ascertaining which, or how many there were, belonging to this animal. His letters to Mr. Featherstonhaugh mention, among others, "the ruins of a very large head, showing the interior structure in a very beautiful manner, with a large portion of the top of the skull."

II. Fossil Elephant. (*Elephas primigenius.* Blumenbach.)

Grinders belonging to a species of elephant, which, in the

opinion of M. Cuvier, do not differ essentially from those of the fossil Siberian, have always formed part of the collections made at Big-bone Lick. Until recently, they had always been found detached, and in small numbers.

It has been also stated that the elephant's teeth found here, were in a great state of decomposition; from which circumstance, and the absence of bones, it has been argued that they were of greater antiquity than the mastodon. But the facts are quite otherwise, as will presently appear.

Remains of elephants, there can be no doubt, formed part of those carried away from this place by General Harrison, and those who preceded him. But what portions, and how many, whether teeth or bones, or both, cannot now be determined. Turner, in 1797, indicated the teeth as different from those of the mastodon, though he did not know what animal they were from.

Goforth states, that he got many teeth of elephants, "some weighing 12lbs." besides tusks, that he supposed were elephants' which is very probable.

Governor Clark brought away several elephants' teeth. Three were sent to France, and most of the remainder are preserved in the cabinet of the American Philosophical Society. But they were all detached molars without any bone, except the lower jaw bones of a young individual mentioned by Wistar, which miscarried on their way from Washington to Philadelphia, and do not appear to have been ever recovered.

Many elephants' teeth, from Big-bone Lick, are shown in the public museum at Cincinnati. They are likewise separate teeth.

Among the teeth that I procured there in the year 1828, were four of elephant, all remarkably sound, and as free from decay as any teeth of mastodon I have ever seen, from Big-bone Lick or elsewhere. Indeed one of them, which was accidentally broke in getting, appears so fresh and sound within, that if I had not seen it taken out of the muddy stream myself, I might have been tempted to suspect some deception, like that mentioned by Cuvier, when a dealer tried to impose upon him by incrusting an African elephants' tooth with marl. Another is an anterior milk molar, like that seen in the head of the Asiatic elephant, figured by Cuvier, pl. IV. f. 5 *h*.

Among the remains disinterred in 1830, was an unusually

large proportion belonging to the fossil elephant. In the Finnell collection, I observed the following.

Two very large tusks, forming a pair. The longer, though part of the large end is broken off, still measures 11 feet 10½ inches in length, and 22 inches in circumference. What remains of the other, measures 8 feet 10 inches, the small end being wanting. Both these are very much curved upward, and a little outward, so as almost to form a complete circle. It is chiefly this peculiar curve, which is so commonly observed in the fossil elephant's tusks found in Europe and Siberia, that induces me to refer this pair to the elephant, of which several large heads, as will presently be seen, were found near where they lay.

Right upper maxillary bone of a large individual, with a large and perfect molar, and part of one side of the great socket of a tusk. The tusks just described may not improbably have belonged to this head; as well as the two next mentioned pieces.

Left upper maxillary, with a large molar tooth.

Large molar, with portions of left lower maxillary.

The greater part of the head of a young individual, comprising the jaws, both upper and under, with parts of the skull. The ascending branch is wanting from the left lower jaw, and is broken off in the right, but is preserved. In the upper jaws are two small molars which had been in use, and the same number below, besides a large germ buried in the right branch, which must have been concealed by the gum.

Twenty separate molar teeth, nearly all entire and undecayed.

An atlas, somewhat mutilated and rubbed, as if by rolling.

This is the only bone in the collection that I could determine to my satisfaction to belong to the Elephant. The more perfect large bones of the extremities appeared to be all mastodon's. The shafts of bones, without articulating surfaces, as well as the vertebræ, which are much broken, may have been in part elephant. My opportunities for comparison were not sufficient to enable me to determine this.

The collection formed at the same time, and in the same spot almost, by Mr. Bullock, is likewise very rich in remains of the elephant. In a letter to Mr. Featherstonhaugh, he states, that he commenced digging immediately after Mr. Finnell discon-

tinued, "and on the third day came to a very fine entire (or nearly so,) head of what I suppose to be the Siberian elephant, four feet long, having all the teeth and one tusk in it. It is the finest fossil I have ever seen, and the only one known except that at St. Petersburgh.

Megalonyx. Jefferson. Cuvier.

It was not until recently that any discovery of remains of this animal was known to have been made, besides those dug out of a cave in Virginia, about thirty-five years ago, and described by Mr. Jefferson, in the American Philosophical Transactions.* From the description given by Goforth, of the bones he found at Big-bone Lick, afterwards carried to England, there was reason to suspect, that among them there was some belonging to the megalonyx. But Mr. Bullock states, that there were none among those which came into his possession. The great claw mentioned in Ashe's account, he says, in a letter to Mr. Featherstonhaugh, was no more than a scapula of some animal, filed down to this shape. Until my journey to Ohio, in 1828, I had no positive information of the megalonyx having been found, except in the one instance, above referred to.

Messrs. Drake and Mansfield, in their "Description of Cincinnati, in 1826," mention "bones of the megalonyx," preserved in the Western museum, in that city. Some of these I saw there, and was informed that they had been obtained by Mr. J. D. Clifford, from the White cave, in Kentucky. Besides these, I found in the same museum, a large humerus of megalonyx, discovered at Big-bone Lick, during one of the searches made there, by order of the proprietors.

Mr. Cozzens and myself found also a metacarpal bone at the same place, no doubt belonging to the megalonyx. This bone, with all those in the Cincinnati collection, have been described

* Although caverns are extremely numerous in the limestone region of the United States, and have been often explored in search of nitrous earth, well authenticated instances of fossil bones found in them, are very rare. The following paragraph is extracted from "*A description of Big-bone Cave, in White county, Tennessee, by D. T. Maddox, Esq. Aug.* 17, 1813," contained in an almanac published in the western country.

"My guide now informed me, that in this apartment had been found bones of a remarkable size and figure. He said, they had dug up the talon of a lion, thirteen inches long, the hoof of an elephant, the ribs of the mammoth, and the skull of a giant; but that they were all destroyed."

The "talon of a lion," here mentioned, may have been an ungueal phalanx, or even a claw, of a megalonyx.

and figured by Dr. Harlan, in the Journal of the Academy of Natural Sciences of Philadelphia.

Two additional instances of the occurrence of these remains were thus determined.

Among those found by Mr. Finnell in 1830, are the following portions of the skeleton of a megalonyx.

A right lower maxillary bone, with four molar teeth.* One of these, the anterior molar, is broken in the middle, and the upper half lost. The bone itself is so much mutilated, that barely enough remains to retain the teeth together, showing the violent action it was exposed to, before being buried.

A detached molar tooth in very good preservation. It differs from all the four in the above described jaw, but not so much but that we may easily believe it to be from the upper jaw of the same animal.

A clavicle, probably of the same.

A tibia, of the right side.

In Mr. Bullock's letter to Mr. Featherstonhaugh, already quoted, he gives a sketch of a bone, of which he obtained four similar, during his late search. They are evidently the ungueal phalanges of a megalonyx.

In the description of the megalonyx by Dr. Harlan, above referred to, he has pointed out some differences in the teeth and bones discovered in the United States, which he considers as indicating two species of this genus. But the scanty materials we up to this time possess, do not, in my opinion, authorise us to decide upon specific characters. With respect to the teeth in particular, it is evidently fallacious to rely too much upon slight differences in them, inasmuch as we now see in the jaw lately discovered, that no two of the four are precisely alike, and the first and fourth, are, in fact, as dissimilar in the outline of their crowns, as possible.

Remains of the megalonyx have also been found in South America. They were brought from Brazil, and placed in the collection of Munich, by the travellers, Martins and Spix. A late writer,† in the Annals of Philosophy, is therefore incorrect, in saying that they have occurred only between the parallels of

* Vide Pl. 3, Vol. I. No. 2, Monthly American Journal of Geology, &c.
† Vid. Ferussac Bull. May 1829, p. 275.

30° and 40° N. lat.* From an account recently published by Dr. Wagner, it appears that the Brazilian megalonyx was like many of the remains hitherto discovered in North America, also found in a cave.

Bos Bombifrons. Harlan.

This extinct species, peculiar, so far as is yet known, to this country, was first distinguished, and its characters pointed out, by the late Dr. Wistar of Philadelphia,† in a paper read to the American Philosophical Society, accompanied with a good figure, in 1817 or 1818.

Cuvier, as late as the third edition of his great work, makes no mention of it, although, unlike the three fossil species enumerated by him, it has the advantage of being so well distinguished from all the living species as to be in no danger of being confounded with any of them. Dr. Harlan first assigned it a place in the system under the expressive name of *Bos bombifrons*.‡

The head described by Wistar was obtained at Big-bone Lick by governor Clark, and is preserved in the Philosophical Society's Cabinet.

In the Finnell collection, I found a second head of this species, much in the same state as that figured by Dr. Wistar, or if any thing, rather less complete. Placed by the side of an analogous specimen of the buffalo, in the same collection, the differences were strikingly obvious.

These two heads are the only remains that have been identified as belonging to this species. Dr. Harlan, however, mentions fossil teeth from Big-bone Lick that he thinks most probably belonged to the same.

Bos Pallasii. Dekay.

This species is now first introduced among those whose remains occur at Big-bone Lick. During my stay there in 1828, a mutilated skull, with part of the core of one horn attached, was found in one of the streams near the great spring, where it had been used as a stepping stone, and brought to me. It is now deposited in the Lyceum of Natural History.

A skull similar to this, which was thrown up by an earthquake near New Madrid on the Mississippi, in the year 1812, forms the

* Vid. Ann. Phil. for June 1831, p. 418.
† Vid. Amer. Phil. Trans. vol. 1. new series, p. 375.
‡ Fauna Amer. p. 271.

subject of a paper in the annals of the Lyceum, by my friend Dr. Dekay. On the supposition that it belonged to the same species with some Siberian heads described by Pallas and Ozcretskoosky, he proposes to call it *Bos Pallasii.* Their strong resemblance to the musk ox is admitted by Cuvier and Pallas, and it is equally apparent in the American specimens, of which I have seen a third, from Ohio, besides the two above mentioned. If they should finally prove to be identical with the *Bos moschatus* it would be rendered doubtful, whether they ought properly to be enumerated among the companions of the extinct races, whose remains are deposited at Big-bone Lick.

Kentucky appears to have been for ages the chosen habitation of many species of the bovine family. Besides the buffaloes, that within half a century abounded in that fertile country, we find at Big-bone the remains of two other species, while a fourth is proved to have formerly inhabited the same neighbourhood: the remarkable skull, a portion of which is preserved by the American Philosophical Society, was found within ten miles. It is the *Bos latifrons* of Dr. Harlan, which Cuvier compares with the aurochs, *Bos urus*, of the old continent.

Cervus Americanus. Harlan.

In the paper which we have several times had occasion to refer to, Dr. Wistar describes an imperfect skull of a species of Cervus, which he found among those brought from Big-bone Lick by general Clarke. A careful comparison of it with the two great species of this genus that now inhabit the United States, led him to conclude that it came from an animal different from both these, and larger than either. Dr. Harlan has also described it in his Fauna, with the name of *Cervus americanus.*

Among the smaller bones discovered in 1830 at Big-bone Lick, and since exhibited in this city, are several belonging to one or more species of deer. The greater part, I have no doubt, are recent bones, but among them is a skull so similar to that figured by Dr. Wistar, and, though very large, so different from that of either the moose or elk, that I did not hesitate to refer it to the extinct species. It is not more complete than Dr. Wistar's specimen, and bears the appearance of having been rolled. These are the only instances of the occurrence of this fossil with which I am acquainted.

[*To be Continued.*]

NOTICES OF BIG-BONE LICK,

Including the various explorations that have been made there, the animals to which the remains belong, and the quantity that has been found of each; with a particular account of the great collection of bones discovered in September, 1830. By WILLIAM COOPER, member of the Lyceum of Natural History of New York, of the Academy of Natural Sciences of Philadelphia, the Zoological Society of London, &c.

(*Continued from page* 174.)

THE six species of animals, of whose remains the preceding catalogue has been given, comprise all of those, found at Big-bone Lick, that in my judgment have a well established claim to be considered fossil, either as being now extinct, entirely, or under the same latitudes, or because they are found associated with the extinct species.

How many individuals there must have been, to have furnished these remains, is an inquiry, not only curious in itself, but which bears upon some speculations regarding the phenomena of their accumulation. Although it can no longer be precisely determined, some approximation may still be made. With this view, I have attempted an estimate from the following data:

The total number of grinders possessed by the mastodon from infancy to old age, as I have elsewhere shown, was twenty-four; of which there were sixteen with three or more pairs of points.

The greatest number of those existing together in the head, and, though not in use, sufficiently ossified to be preserved fossil, was twelve.

The number existing and in use at the maturity of the species, was eight.

At last in old age there remained but four, as in the Elephant.

Supposing each individual to have been of mature age, neither

very old, nor very young, (though examples of both have occurred here, and may balance each other,) the fair average number of grinders to be allowed him, is, therefore, eight.

The whole number of teeth in the Finnell collection with not less than three pairs of points, is, including those in the jaws ninety-four; which, with twenty-six similar, brought by me from the same place, makes one hundred and twenty. This, divided by eight, gives fifteen as the least number of individuals that could have furnished the teeth, contained in these two collections alone.

To these are to be added, all that have been removed by Harrison, Goforth, Clarke, Bullock, the citizens of Cincinnati, and very many others; besides some, that, it is to be presumed, still remain in the bed.* If six or seven times the number are allowed for all these, it would certainly not exceed the probability. In fact I should be more inclined to say ten or twenty times as many; and were big-Bone Lick on the top of a mountain, we might be tempted to think, that the whole race had retreated hither, to escape some general inundation.

The number of individual elephants, might be conjectured in the same manner. They appear to have been to the mastodon, about as one to five. The smaller quadrupeds are probably fewer than might have been obtained, if more care had been used to collect and preserve them. In the following table, which is intended chiefly to show the proportions the several species appear to bear to each other, I have put down no more of these, than are known to have been found.

SPECIES.	NO. OF INDIVIDUALS.
Mastodon maximus,	100
Elephas primigenius,	20
Megalonyx Jeffersonii,	1
Bos bombifrons	2
—— *Pallasii,*	1
Cervus americanus,	2

It is true that the remains of several other animals besides those just enumerated, occur abundantly at Big-bone Lick; and

* Mr. Bullock, however, who has been at much pains and expense to determine this, is of opinion "that all the strata near the Salt Lick of Big Bone, that contain animal remains have been examined." See letter to Mr. Featherstonhaugh.

I have myself, collected the bones of three or four more at this place; the horse, the bear, the buffalo, and two or three species of deer, have been recorded among the fossil animals. But none of these appear to me to merit that epithet in the geological sense of the word.

Except the first, they are all animals indigenous to the country, and there would be nothing surprising in finding their bones near the surface, or even, sometimes, at the depth of several feet, when it is recollected how often the ground has been disturbed by repeated diggings. Bear's bones from this locality, I have never seen, nor indeed of any carnivorous animal, which I consider a remarkable circumstance. Antlers, jaws, and other remains of Cervus canadensis, C. virginianus, C. alces, and perhaps C. tarandus, are not very rare. I think I have observed among the collections made at Big-bone Lick, traces of each of these. But they bear no proportion to those of the buffalo, whose bones are dispersed through the alluvial soil, or strewn over the surface in great abundance. The buffalo in modern times, as perhaps the mastodon in past ages, seems to have nearly monopolized this favourite haunt to himself. With the horse, the case is different, inasmuch as this animal is generally believed not to have been an aboriginal inhabitant of this continent.* But it is not at all necessary to suppose that he was so, to account for the simple circumstance of finding a few of his bones at this place. Within a few yards of the spot where the excavations of last September were made, are the vestiges of a fort, and several wells, the work of the first settlers of Kentucky, about forty or fifty years ago. They doubtless brought horses with them, some of which may have died here, and their bones might easily have become more or less covered with earth in a place where wells were dug, and the ground tilled, as it has been here, for many years past. Nothing in regard to this point can be argued from the state of preservation of any remains found at Big-bone Lick. I have now before me a tooth of a megalonyx found here, apparently as sound and fresh as any of the recent horse or buffalo.

If any well identified remains of the horse had been found associated in the same bed, with those of the extinct animals, in spots well known not to have been previously disturbed, we could not refuse to admit their equal antiquity with the rest. But I do

* Our author will find many individuals, entertaining a different opinion.—Ed.

not think that this point has been sufficiently made out. I saw nothing in support of it myself, nor have I met with any person who could answer for such a fact, from his own careful observation. In the case of those recently exhibited in this city, one of the proprietors who assisted in disinterring them, acknowledged to me, that the horses' bones were generally near the surface, although part of a skull was found at the depth of twelve or fifteen feet; but that they were all separated from the great bones, which lay at the depth of twenty two feet, and *in a different kind of soil.* Mr. Bullock, it is true, states that "the bones of the horse were found at various depths, from five to twenty feet, indiscriminately with the other bones."

When the report printed in the first number of this Journal was presented to the Lyceum of New York, I was inclined to a different opinion, having been led to suppose that all the bones and teeth exhibited as fossil, had been found lying promiscuously together. But finding, upon stricter inquiry, that this was not the case, and that part at least of those belonging to the horse were undoubtedly recent, I consider it best to wait for more certain evidence before admitting the existence of an ancient race of this genus upon our continent. It is not a new thing, however, to hear of fossil remains of horses in this country. The first printed notice of them, as far as I am aware, is contained in Mitchill's "Catalogue of Organic Remains," pp. 7 and 8. They consist of a vertebra and several teeth found in New Jersey. In the collection of the Lyceum are likewise others, represented as fossil, from other American localities, but I know not upon what evidence.

On the Position of the Organic Remains at Big-bone Lick.

Nearly in the centre of the valley in which the great bone licks are situated, as may be seen by the map,* is a fountain, called by the inhabitants the Gum Spring. It is the most copious, and the most distinguished for the peculiar properties of its waters of all that the valley contains. Opposite to this is a small island, formed by the division of one of the two principal branches of Big-bone creek, at its north-east point, one arm passing by the great spring, where it unites with the other branch, while the main body continues round the south side of the island, at the

* See pl. 5, vol. I. No. 4, Monthly Journal of Geology, &c.

south-west point of which they all unite their waters to form Big-bone creek.

The fossil bones have all been found on the east and south-east sides of the Gum Spring, either along the western branch of the creek, about the point opposite the spring, or on the island; but always, except in a very few instances, within fifty or sixty yards of this spring. Within so small an area has been gathered the extraordinary quantity of which I have endeavoured to convey some idea in the preceding pages. Many excavations have been made in other parts of the valley, some in search of bones and others for salt water. At what is called the Big Lick, where a number of lime springs form a small miry spot like that at the Gum Spring, and about one hundred and fifty yards from it, a well has even been dug, and the soil examined to the depth of twenty-five or thirty feet, without any bones being met with. Yet here there would be the greatest probability of finding them if any where besides the spot described.

It appears from various accounts, that at the period of the first settlement of the country the great bones were either lying on the surface of the ground, or so near it as to be obtained with very little labour. It is even said that they were so numerous on the surface about fifty years ago, that a person might walk over the lick by stepping from one to another, without touching the ground.

Croghan gives the following short description of this place as he found it about twenty years previous to the occupation of the country by the whites. It is extracted from his manuscript journal of a voyage down the Ohio, now in the possession of Mr. Featherstonhaugh.

"30th, (May 1765.) We passed the great Miami river about 30 miles from the little river of that name, and in the evening arrived at the place where the elephants' bones are found, where we encamped, intending to take a view of the place next morning. This day we came about 70 miles.

"31st. Early in the morning we went to the great lick where these bones are only found, about four miles from the river on the south-east side. In our way we passed through a fine timbered clear wood. We came to a road which the buffaloes have beaten, spacious enough for two wagons to go abreast, and leading straight into the lick. It appears that there are vast quantities of these bones lying five or six feet under ground, which we

discovered in the bank at the edge of the lick. We found here two tusks above six feet long, we carried one, with some other bones, to our boats and set off. This day we proceeded down the river about 80 miles."

According to General Collaud, as quoted by Cuvier, the bones lay about four feet deep. General Harrison and Governor Clarke have never given any information on this head that I am aware of.

Goforth relates, " we dug through several layers of small bones in a stiff blue clay, such as deer, elk, buffalo and bear, in great numbers, many much broken, below which was a stratum of gravel and salt water, in which we found the large bones, some nearly eleven feet deep in the ground, though they were also found on the surface."

So recently as the summer of 1828, when I visted this place, bones of the larger animals were still to be found close to the surface, or in the bed of the stream near the great spring. Some of these, it was evident, had been previously disturbed, and therefore no longer occupied their ancient position. But some teeth which I obtained were so large and so finely preserved, that they certainly would not have been left if they had been sooner discovered. These lay in a very low place, within less than two feet of the surface, and near the edge of the stream on the east of the Gum Spring.

The bones discovered in 1830, by Messrs. Finnell and Bullock, were found under somewhat different circumstances from those just described. The following particulars, gathered from one of the proprietors who was present at their disinterment, and corroborated by the letters of Mr. Bullock, may be relied on.

They were procured on the north side of the island, a little east of the great spring, and about fifty or sixty yards from it. The pit or well, originally dug by Mr. Finnell, was nine feet wide and about twenty-five deep. Mr. Bullock, thinking Mr. Finnell had not thoroughly examined it, afterwards re-opened and enlarged it in width and depth, and found many bones; all, however, on the same level, and none deeper. The great bones were first met with at the depth of twenty-two feet, lying in a bed of about three feet in thickness. The two great heads of mastodon, and the large elephants' head found by Mr. Bullock, were lying near together. Below them, were three of the large

tusks, and intermingled with all these a large quantity of teeth and bones, of various animals. "They altogether formed," says Mr. Bullock, "a heterogeneous mass, lying horizontally, mixed with angular and waterworn pieces of limestone of various sizes, which contain marine shells, and rounded specimens of quartzose and other pebbles, as well as fragments of cane, small, unknown to me, and also fragments of broken fresh-water shells, much resembling those now living in the neighbourhood." I have been moreover informed, that immediately beneath the great bones, the workmen came to a bed of stiff blue clay, in which, except at its surface, no bones were found. This agrees with my own observations and all the accounts I have heard, except Goforth's, according to whom, the great bones were partly found beneath the blue clay. I saw, it is true, the entire skeleton of a buffalo, with part of two others, dug out of the blue clay, where it is found immediately at the surface. But there were no remains of the extinct animals, either with these or under the clay, which I saw penetrated down to a dry stony layer of a kind of marl. The buffaloes appeared to have sunk or been trampled into the clay, while soft from the effects of rain or floods.

The great inequality of the ground near the spring, is the principal cause why some were obliged to dig twenty-two feet before finding bones of the large species, while others met with them at eleven, four, two feet, or even less. The surface of the island, for example, is much higher than that of the point, on the north of it; and this, than the bed of the stream; so that by digging two feet in one place, we would reach the same level that we would by digging twenty feet, not many yards further off.

The position of the bones, fossil and recent, such as I have determined it from the comparison of the foregoing accounts, with my own observations made at the place, shall be now described.

The substratum of the neighbouring country, is a limestone, abounding in organic remains. This appears at the surface on the sides and tops of the hills, and along the banks of the great rivers. From it must have been derived the fragments mentioned in Mr. Bullock's account, as found accompanying the great bones. But at this lick, the valley is filled up to the depth of not less, generally, than thirty feet, with unconsolidated beds of earth of various kinds. The uppermost of these consists of a light yellow clay, which, apparently, is no more than the soil brought

down from the higher grounds, by rains and land floods. In this yellow earth are found, along the water courses, at various depths, the bones of buffaloes and other modern animals, many broken, but often quite entire.

Beneath this alluvial bed, is another thinner layer of a different kind of soil, presenting much of the character of a sediment, from a marsh or river. It is more gravelly, darker colored, softer, and contains remains of reedy plants, smaller than the cane so abundant in some parts of Kentucky, and shells of fresh water mollusca. It appears to be, in short, what is meant by diluvium, as distinguished from the alluvium, which forms the bed above it.* In this layer, resting upon, and sometimes partially imbedded in a stratum of blue clay of a very compact and tenacious kind, are deposited the bones of the extinct species. Originally near the surface, they have been gradually covered by the accumulation of alluvial matter above them.

The depth of this alluvium is, however, variable. In some places it is very thin, and in others is liable to be entirely washed away by the inundations which are common here at some seasons of the year. When this takes place, the blue clay is left bare, and the bones exposed on the surface. It is in such situations, and along the banks and bed of the streams, that they have been found nearly or quite uncovered. The Gum Spring, as may be seen by the map, is in the lowest part of the valley, near where the torrents from the surrounding hills meet, before they find a common outlet. The eastern branch of the stream, a few years ago, forced itself a new channel on the north side, of what thereby became the island, and united with the western, opposite the spring, instead of their former confluence at the south-western point. In this new channel I found several finely preserved teeth and bones of the extinct animals.

The side of the island which forms the south bank of the stream, opposite the spring, is steep, and much elevated above the surface on the other side, the yellow alluvial soil having accumulated to a great height. Consequently, the bones which were found here in 1830, were deeply buried, as has been de-

* The difference between it and the upper layer is so obvious, even to the workmen, who have been employed in digging here, that they have, with propriety, denominated it, the "bone soil;" and this distinction is recognised whenever they meet with it, even in places where it does not contain bones.

scribed, but were, notwithstanding, on a level with those previously obtained in the low grounds to the north of them.

On the Theory of Big-bone Lick.

It is natural, at the first view, to suppose that the herds of elephants and mastodons were attracted hither by the salt, which they probably found as agreeable a condiment as the modern herbivorous animals; and that, like many of these, they died at the spot where their remains have been discovered. Such is the opinion of the present inhabitants, as well as of most persons who visit the place; the sound condition of the bones, being naturally attributed to the antiseptic properties of the water of the adjacent springs. There can be no doubt of the conservative quality of these; and it is highly probable that without it, the bones would scarcely have remained till now so free from decay as we find them. But they might easily have been preserved, at least for a considerable period, like those of which so many instances have occurred both in Europe and America, without this aid. Moreover, it may be well doubted whether these salt springs formerly existed here. Bones are not always found at salt licks, even in Kentucky. There have been other instances besides this; but the exceptions are, I believe, much more numerous. In New York I have never heard of fossil bones being discovered at Onondaga, or any other of the numerous salines of this state; although not at too great a distance from the Wallkill, where these relics abound, to have been beyond the range of the same animals.*

At the same time, however, I can readily admit, that they inhabited the neighbouring country, and that a few, perhaps, were at the spot, or dispersed through the surrounding woods and marshes, when the catastrophe occurred, which seems to have extinguished their race.

Some of the appearances which the bones exhibit, have been alluded to in the course of our previous descriptions; very few, indeed, if any, even of the smallest, were found without some mark of their having been subjected to violent action. Unlike those of which so many have been discovered in New York and

* Part of an elephant's tooth, preserved in the Museum of the Albany Institute, and said to have been found somewhere along the line of the Erie canal, is the only instance within my knowledge of fossil remains of these animals from that part of our state.

New Jersey, where the animals seem to have perished quietly on the spot where their remains are found, the parts belonging to each individual lying near each other, and sometimes entire skeletons without a bone displaced,* the frames of those found at Big-bone Lick, seem rather to have been torn asunder, and intermixed in the most promiscuous disorder, before they were permitted to find here a place of rest. It is rare to meet with a single bone of the large animals, or of those smaller ones, that accompany them, that is not more or less bruised or broken. Of all the under jaws brought from this place, I have seen but one, in which at least one side was not wanting; and in this the teeth were all gone. This cannot be ascribed to brittleness from decay; for, as is well known, the bones found here are remarkably hard and solid. Still they are much less entire than those found in the state of New York, whose texture is generally impaired by decomposition. Some of those, which I collected at Big-bone Lick, have their cancelli entirely filled with stony matter, by which their weight and hardness are much increased. But generally, they look like fresh bones; and the fact of their retaining gelatine, which I have verified, is well known.

Mr. Bullock says, in his account of those discovered last year, which were too deeply buried to leave room to suspect that they had been ever before disturbed, since they were brought to the spot where he found them, "many of the bones are much waterworn and broken; scarcely any that are not so, more or less. Some large fragments of the tusks of the elephant are worn quite flat and smooth, as if they had lain half buried in a water course, and worn down by the action from above." In fact, the mere circumstance of finding so large a number of detached teeth as has been often found, lying together within a small compass, is alone sufficient to prove that the owners did not perish where these lie. In that case, the teeth would have remained in the respective heads, and have, consequently, occupied a much larger space. The teeth of buffaloes, which there is every reason to believe died from time to time at or near the spot, are never met with in heads separated from the bones, as is the case with those of the elephant and mastodon.

It has been attempted to account for the heaping up of the bones and teeth found last autumn, which it is said formed a sort

* See Annals, Lyceum of N. Y. vol. I. p. 143.

of pyramid, with three great tusks encircling its base, and surmounted by the great head discovered by Mr. Finnell, by ascribing it to the aborigines, who, it was supposed, may have amused themselves by piling them up in this manner. In that case, it must have been done in some very remote age, to allow time for two distinct beds of soil to have accumulated over them to the height of twenty-five feet, and in a place where these operations are carried on upon so small a scale. But some allowance must be made for the effects of the imagination in those who thought they saw such appearances of order in this ancient charnel house, which, if it really existed, it would be difficult to verify under such circumstances.

Similar heaps of fossil bones of elephants and other extinct animals, have been discovered, in several parts of Europe, though it has not been pretended, that they were brought together in this manner. Indeed the human race has been supposed, not to have inhabited the same countries at the epoch of the deposition of these bones. One instance occurred at Selburg, near Canstadt on the Necker, in 1816, where was discovered "a group of thirteen tusks and some molar teeth, of elephants, heaped close upon each other, as if they had been packed artificially."* Another was at Thiede in Brunswick, in the same year, where a congeries of tusks, teeth, and bones, belonging to the elephant, rhinoceros, horse, ox, and stag, was found in a heap, of ten feet square. There were no less than eleven tusks of elephants, some being of the largest size ever discovered. The appearances they presented, as described by Dr. Buckland, were altogether so strikingly similar to those observed in the pit dug at Big-bone Lick, that it is no more than reasonable to ascribe them to the same cause.

But, at the same time, that we find so much reason to suppose that the great bones, as well as those of the other extinct species, have been brought hither, since the death of the animals, and probably by the agency of water, it does not seem probable that they have been transported from a very great distance. Most of the appearances they afford, seem to indicate sudden and violent, but not long continued action. Even the thickest and strongest bones are found, broken short off into several truncheons, but the edges and angles of the fractures are commonly sharp, and not rounded, as much rotting would have made them. The

* Buckland Reliq. Diluv. p. 180.

grinders are found entire, with broken, but undecayed portions of bone entangled between their roots. Such as appear rubbed, or waterworn, may be those that have been washed out of their ancient bed, in modern times, or may have been the remains of individuals that died before the general destruction. The laterally worn tusks, already described, perhaps belonged to some of these; and this abrasion may have been slowly effected, before the comminution of the others took place, and by different means. If, during some general inundation, a whirlpool had formed in this valley, from which, after much violent collision, these bones were deposited, the heads, teeth, and tusks, and other hard and heavy parts settling down together, where is now the great spring, many of the remarkable circumstances we have noted, would be explained. Dr. Buckland, in endeavouring to account for the similar accumulations of various teeth, and bones found in Germany, says "they were most probably drifted together by eddies, in the diluvian waters."* I had not observed this passage, when I was led to account in the same manner, for the pile at Big-bone Lick; which I mention, merely to show how naturally this idea suggests itself.

I do not venture to say any thing with regard to the period at which this event may be supposed to have taken place. The natural phenomena do not furnish data sufficient to enable us to fix upon this with any degree of precision. I will merely observe, that it must be referred as far back as we can conceive it possible for animal substances to be preserved under the circumstances described.

Enough has been established, however, to authorize us to conclude, that the region which borders the Ohio was formerly inhabited by different animals from those which have peopled it from the earliest times of which we possess any account.

Two of these, the mastodon and megalonyx, belonged to genera now unknown, but having much affinity to some that still inhabit the torrid zone. The former, though allied to the elephants, was materially different in the teeth and some other particulars, indicating a considerable difference in habits. The other was allied to the sloths, and their co-ordinate genera, but was greatly superior in size to any species now living.

* Buckland p. 181.

A third belonged to a very natural genus, of which two species exist in the warm regions of the old continent; but this was specifically different from both, and, as regards America, the genus even is entirely extinct.

There were likewise others which belong to the same genera with some now naturally inhabitants of the same region. These are two species of bos, and one of cervus.

There is no evidence of any animals of the carnivorous order having accompanied them.

They appear to have perished by the agency of water, which, after transporting their remains a moderate distance, deposited them in a mass where they have since been found.

They were succeeded, after an interval, by the species which now inhabit the country.

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